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*Indian Standard*

METHOD OF  
DETERMINATION OF  
ALKALI RESISTANCE OF GLASS

UDC 666.11 : 620.193.423



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INDIAN STANDARDS INSTITUTION  
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 110002

Price Rs 5.00

August 1979

Gr 2

# *Indian Standard*

## METHOD OF DETERMINATION OF ALKALI RESISTANCE OF GLASS

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# *Indian Standard*

## METHOD OF DETERMINATION OF ALKALI RESISTANCE OF GLASS

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 30 December 1978, after the draft finalized by the Glassware Sectional Committee had been approved by the Chemical Division Council.

**0.2** In the production of glassware its end use is an important consideration. For this it is necessary to ensure that glass having appropriate characteristics is chosen. Chemical durability of glass is one of the most important characteristics which determine suitability of a glass and comprises resistance of glass to attack by water, acids and alkalis depending on the nature of the medium in contact with it. This standard prescribes the method for determining resistance of glass of attack by alkali and its classification on that basis into three types. Suitable methods for determining resistance of glass to attack by water and acidic medium and its classification into suitable types have already been covered in IS : 2303-1963\*.

**0.3** In the formulation of this standard considerable assistance has been derived from the following:

ISO/R 695-1975 Glass — Determination of the resistance of glass to attack by a boiling aqueous solution of mixed alkali. International Organization for Standardization.

DIN 52322 : 1967 Testing of glass — Determination of alkali resistance. Deutscher Institut für Normung.

**0.4** In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960†.

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\*Method of grading glass for alkalinity.

†Rules for rounding off numerical values ( revised ).

## 1. SCOPE

**1.1** This standard prescribes the method for determining resistance of glass to attack by alkali ( a boiling aqueous solution of equal volumes of 1 N sodium carbonate and 1N sodium hydroxide ) and its classification.

## 2. TERMINOLOGY

**2.1** For the purpose of this standard, the following definition shall apply.

**2.1.1** *Resistance of Glass to Alkali* — is the chemical resistance of the glass surface to leaching by boiling aqueous solution of equal volumes of sodium carbonate and sodium hydroxide and is expressed inversely to the loss in mass per unit area ( mg/dm<sup>2</sup> ).

## 3. SAMPLING

**3.1** Representative samples of items of glassware shall be drawn as prescribed in the individual material specification.

## 4. APPARATUS

**4.1 Test Vessel** — of pure silver or alkali-resistant silver alloy. A suitable vessel is illustrated in Fig. 1. The vessel is cylindrical with a hemispherical base and has a close fitting lid. The lid has a wide neck and is fitted on the underside with four hooks for suspending test pieces. Where a gasket is required to ensure an adequate joint between the body of the vessel and the lid, it shall be of a material which remains inert under the conditions of test.

**4.2 Glass Condenser** — bulb condenser or a plain condenser ( *see* IS : 6052-1970\* ) fitted to the neck of the vessel through a bung of suitable inert material which has previously been boiled for 60 minutes in water.

**4.3 Balance** — with an accuracy of  $\pm 0.1$  mg.

**4.4 Desiccator** — ( *see* IS : 6138-1977† ) containing a suitable drying agent.

**4.5 Measuring Instruments** — suitable for measuring length and diameter to the required accuracy ( *see* 7.1 ).

**4.6 Drying Oven** — suitable for operation at a temperature of 150°C.

**4.7 Beaker** — of 1 litre capacity ( *see* IS : 2619-1971‡ ).

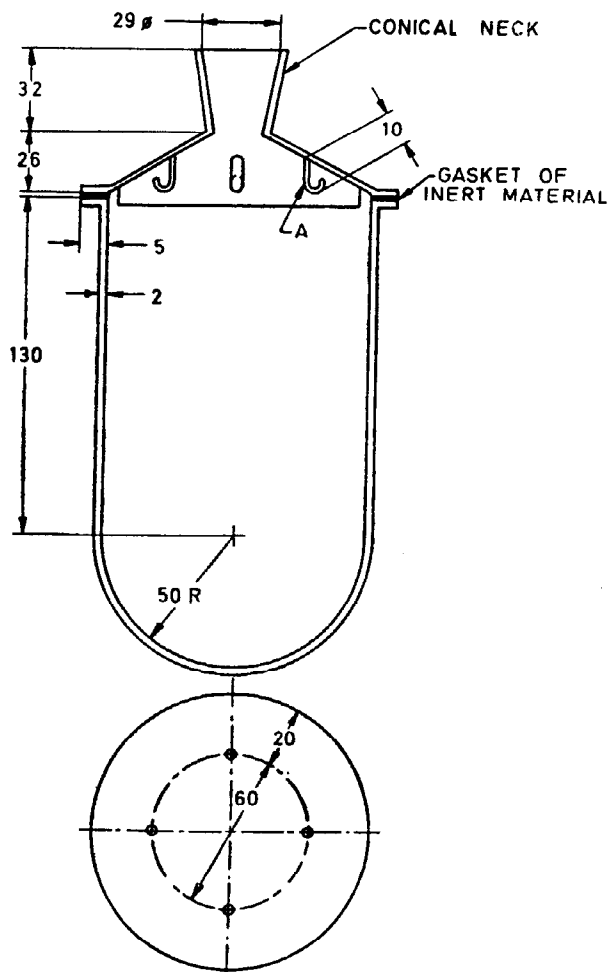
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\*Specification for glass condensers.

†Specification for desiccators.

‡Specification for glass beakers ( *first revision* ).





VIEW OF LID FROM ABOVE, SHOWING POSITION OF HOOKS

$A = 4$  hooks soldered to cover, 1 flange with ground flat surface, fixed to lid.

All dimensions in millimetres.

FIG. 1 SILVER VESSEL FOR DETERMINING ALKALI RESISTANCE OF GLASS

#### **4.8 Silver Wire**

**4.9 Tongs** — tipped, if necessary, with a suitable material.

**4.10 Heating Device** — suitable for heating silver vessel.

### **5. REAGENTS**

**5.0 Quality of Reagents** — Unless specified otherwise, pure chemicals and distilled water ( *see* IS : 1070-1977\* ) shall be used in the test.

NOTE — ' Pure chemicals ' shall mean chemicals that do not contain impurities which affect the results of test.

#### **5.1 Acetone**

**5.2 Acetic Acid** — 5 percent (  $v/v$  ).

**5.3 Hydrochloric Acid** — approximately 1 N.

**5.4 Sodium Carbonate Solution** —  $1 \pm 0.02$  N, freshly prepared for each test.

**5.5 Sodium Hydroxide Solution** —  $1 \pm 0.02$  N, freshly prepared for each test.

### **6. PREPARATION OF TEST PIECES**

**6.1** Cut pieces of the glass to be tested, such that the total surface area lies between 10 to 15 cm<sup>2</sup>. Remove any sharp angles, ' hackles ' or splinters by a minimum of grinding; do not fire-polish the edges.

### **7. PROCEDURE**

**7.1** Calculate the total surface area of the test piece(s) to an accuracy of 2 percent, linear measurements being made to an accuracy of  $\pm 1$  percent. Record the value of area(s) obtained (  $A$  cm<sup>2</sup> ). Thoroughly wash the test piece(s) with acetic acid, then, using the tongs to hold the glass ( as in subsequent operations ), wash three times with separate portions of water and finally rinse with acetone. Dry the test piece(s) in the oven at  $140 \pm 5^\circ\text{C}$  for 30 to 40 minutes, transfer to the desiccator and allow to cool to room temperature. Finally, weigh to an accuracy of 0.1 mg. Record the mass (  $M_1$  mg ).

**7.1.1** Transfer 800 ml of a mixture of equal volumes of sodium carbonate and sodium hydroxide solutions to the test vessel and heat to boiling by placing the vessel inside the electrically heated air oven through a circular hole at the top in such a way that the lid can be opened or

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\*Specification for water for general laboratory use ( *second revision* ).

closed from outside. Suspend the test piece(s) and by silver wire sling from the hook(s) on the underside of the lid of the vessel. Fix the lid in position so that the test piece(s) is/(are) immersed in the boiling solution completely and no contact is made with the wall of the vessel (or between pieces themselves). Fit the condenser to the lid of the vessel, turn on the flow of water through the condenser and continue boiling for 3 hours.

**7.1.2** Remove the test piece(s) from the boiling solution and submerge three times in 500 ml of hydrochloric acid. Wash the test piece(s) three times with separate portions of water and finally rinse with acetone. Dry the test piece(s) in the oven at  $140 \pm 5^\circ\text{C}$  for 30 to 40 minutes, transfer to the desiccator and allow to cool to room temperature. Finally weigh to an accuracy of  $\pm 0.1$  mg and record the mass ( $M_2$  mg).

**7.1.3** Repeat the procedure with new test piece(s) of glass with fresh solutions.

## 8. CALCULATION

**8.1** From each of the results obtained, calculate the loss in mass per unit surface area as follows:

$$\text{Loss in mass/unit surface area, mg/dm}^2 = \frac{100 (M_1 - M_2)}{A}$$

## 9. ASSESSMENT OF RESULTS

**9.1** Disregard value of loss in mass per unit surface area obtained as in **8.1** differing by more than  $\pm 5$  percent from the mean value and calculate the new mean from all remaining results, which shall be not less than four in number.

## 10. CLASSIFICATION OF GLASS

**10.1** Glass shall be classified into 3 classes of quality, based on its resistance to attack by alkalis, as follows:

<i>Loss in Mass per Unit Area, mg/dm<sup>2</sup></i>	<i>Quality of Glass</i>	<i>Class of Alkali Resistance</i>
0 to 75	High alkali resistance	1
Over 75 but up to 150	Medium alkali resistance	2
Over 150	Low alkali resistance	3

**IS: 9154 - 1978**

**11. TEST REPORT**

**11.1** Test report shall contain reference to this standard, average loss in mass per unit surface area (  $\text{mg}/\text{dm}^2$  ) and Class of alkali resistance.